

surrounding matter, and immediately pass into adjacent atoms. This view materially reduces the number of corpuscles required for the transfer of electricity. In both these forms of theory the atoms of the metal itself are supposed immobile, and to play no direct appreciable part in the transfer of the current.

The important question of the type of radiation to be expected from a metal on the above theories is fully considered. Since the corpuscles are suddenly started and stopped, they must radiate energy in the form of thin pulses analogous to the pulses which are supposed to constitute the Röntgen rays. Lorentz has shown that if this radiation be analysed by means of Fourier's series, the amplitude of the long waves agrees closely with that deduced independently of such assumptions by means of the thermodynamical theory. Prof. Thomson, however, points out that the main radiation must consist of short waves analogous to very easily absorbed Röntgen rays. It would be of great interest and importance if the presence of such a type of radiation from metals could be experimentally detected. In another chapter the author explains the construction and properties of his well-known "model" atoms built up of rings of rotating corpuscles. No one can fail to admire the ingenuity displayed in the construction of such atoms, and in showing the remarkable way in which they imitate many of the known properties of the atom. On this hypothesis the properties of the atom are dependent on the number and arrangement of the negative corpuscles. The corresponding positive electricity, which is distributed throughout the volume of a sphere, merely serves as a cement to hold the atom together. This form of atom, while it has many advantages from the point of view of calculation, is somewhat artificial, for it implicitly assumes very peculiar properties for the positive electricity. To say that a positively charged body is one that has lost a negative corpuscle is not an explanation, but begs the question of the nature of positive electricity. The trend of modern views is to diminish in some directions the importance of the negative charge and to emphasise that of the positive. This is borne out by the author's estimates that the number of free corpuscles in an atom is about the same as its atomic weight in terms of hydrogen. Until we have a clearer idea of the nature of positive electricity we cannot hope to form a clear view of the constitution of the atom. The proof of the existence of a positive electron—the counterpart of the negative—if such exists, would be of enormous importance to theory and experiment. The problem of the nature of positive electricity is now very much to the fore, and it is to be hoped that we shall not have to wait too long for a solution.

Like all Prof. Thomson's books, the present volume is lucidly and simply written, while the mathematical analysis required for the development of the consequences of the theory is made as simple as possible. To all those interested in the latest views of the connection between electricity and matter this book will be very welcome.

E. R.

CHARTING THE WORLD'S COMMERCE.

Atlas of the World's Commerce. Compiled from the Latest Official Returns at the Edinburgh Geographical Institute, and edited by J. G. Bartholomew. (London: G. Newnes, Ltd.) Twenty-two parts, each 6d. net.

MR. BARTHOLOMEW is a skilled hand at map-making, and in setting himself to chart the commerce of the world he has undertaken a gigantic task. With the aid of 176 large pages of coloured plates, containing more than 1000 maps and diagrams, he attempts to describe the products, imports, exports, commercial conditions and economic statistics of all the leading countries of the world, and he says quite justly that the successful accomplishment of such a work must throw much needed light on the solution of the great problem of international trade which we in British politics call "the fiscal question." His first object is to show whence we derive our food, drink, clothing, and all that we use in our daily lives. No better text could be chosen for the enlightenment of our politicians, whatever be their fiscal views, and indeed of all who would understand where England really stands in the world of commerce, and what are the essentials of her future as the central force of a great Empire.

The very immensity of Mr. Bartholomew's undertaking tends to lessen its topical value. For instance, the last three years have been momentous in their effect upon the sources of British food supply, and Mr. Bartholomew can be of little help to the man who would understand how far we are dependent upon foreign and how far upon colonial supplies, when he only carries us down to the year 1903. Canada, for instance, figures in Mr. Bartholomew's diagrams as yielding less than 86 million bushels of wheat. The produce of her western section alone was in 1906 considerably in excess of that figure. The fiscal controversy is especially associated with the food production of the newer countries, and the usefulness of Mr. Bartholomew's diagrams, so far as the fiscal controversy is concerned, goes little beyond the course of our dependence upon the older countries, such as the United States, Russia, &c. For his distribution of the chief sources of the British supply of wheat, Mr. Bartholomew brings us no further down than the 1901-3 average, from which we see that the Canadian percentage was 8·4 and the United States percentage 43·5. The limited usefulness of such figures is evident when it is noted that in 1906 the Canadian proportion was at least 12½ per cent. and the United States proportion 37 per cent. There may have been insuperable difficulties in carrying the averages down to a more recent period, but it is obvious that, in the absence of more recent figures, it is necessary to endorse with qualification Mr. Bartholomew's claim that in his new atlas "the whole fiscal question is clearly illustrated."

We may note one other respect in which the topical usefulness of Mr. Bartholomew's investigations is limited, and it is a vital one. In dealing with the import and export trade of the United Kingdom

(p. 33), the imports are lumped together with no allowance for the fact that in some cases large proportions are re-exported, and therefore, except from the point of view of the shipper, the gross totals throw no light on the industry of the country, in fact they can only mislead. The importance of this allowance for re-exports is shown in the textile group. Thus, of the 52,400,000. worth of imports of cotton, no less than 7,000,000. worth was re-exported, and of the wool imports of 26,600,000. no less than 11,200,000. If Mr. Bartholomew had these calculations in mind, he would hardly have ventured upon the conclusion he draws in a note to this diagram in the following words:—

“It is at once evident that articles of food greatly preponderate, the value amounting indeed to 40 per cent. of the total. Raw material accounts for more than 28 per cent., of which 16½ represent textile fibres.”

But we would not leave Mr. Bartholomew's atlas without a recognition of the enormous labour it must have involved, and of its successes in several directions. The maps are excellent, and the table of the commodities of commerce and the gazetteer of countries and ports of the world have obvious uses.

MASONRY AND CONCRETE ARCHES.

Symmetrical Masonry Arches. By M. A. Howe. Pp. x+170. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1906.) Price 10s. 6d. net.

THE author's object in this text-book has been to present in a simple and direct form a method which can be employed in the design of masonry arches according to the elastic theory. He points out that since such arches are built of materials and under conditions which are more or less uncertain in character, the use of rigidly accurate formulæ is not necessary.

The first portion of the book consists of two chapters, in which the various formulæ which are required in the design of such arches are deduced, and then several examples are worked out in detail to illustrate the application of the formulæ. Independent formulæ are obtained for the effects of bending, axial thrust, and temperature; these formulæ are then combined, but the author points out that as the effect of axial stress is small, except in very flat arches, it may in general be neglected in obtaining a combined formula. For symmetrical arches fixed at the ends, the following conditions must be satisfied, viz., the central angle and the relative elevations at the supports must each remain unchanged, and the length of span must remain constant; Mr. Howe is therefore able to obtain three equations involving the three unknown quantities—moment, vertical reaction, and horizontal thrust at the supports of the arch. He then proceeds to deal with a number of special cases of loading, and discusses fully the temperature effects; graphical representations are frequently used to show the results obtained by analysis.

The last part of this portion of the book is devoted first to a discussion of the trustworthiness of the

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elastic theory when applied to ribs composed of natural stone voussoirs, and to plain and reinforced concrete ribs (the author comes to the conclusion that the theory may be used with confidence so long as no tensile stresses occur); and secondly to a collection of empirical formulæ for the thickness of the ring at the crown and at the supports in stone arches, and for the thickness of the abutments. The examples of the applications of the formulæ, which are fully worked out, cover the following cases:—(1) An arch for a single-track railway bridge of 60-feet span and a rise of 8 feet, the arch ring to be constructed of granite; (2) an arch with a clear span of 50 feet and a rise of 10 feet, constructed of reinforced concrete (in both cases the maximum stresses produced by dead load, live load, and changes of temperature are computed); (3) the author takes again the data employed in the second example, and gives an ingenious and much shorter method for working out the values of the horizontal reactions and bending moments at different sections of the arch. In the fourth chapter, dimensioned illustrations are given of a few typical arches, and, in the form of an appendix, data have been brought together for 500 arch bridges of masonry, plain concrete, and reinforced concrete. The data in this appendix will be of considerable service to engineers who may be called upon to design arch bridges of one or other of these materials.

T. H. B.

OUR BOOK SHELF.

Das Kausalitätsprinzip der Biologie. By Dr. Friedrich Strecker. Pp. viii+153. (Leipzig: W. Engelmann, 1907.) Price 3 marks.

VON BAER said that the chief end of biology was to refer the formative forces of organisms to the general forces and vital directions (*Lebensrichtungen*) of the Kosmos. According to the mechanists this is rapidly being done; according to the neo-vitalists this is not being done at all, for the characteristic activities of living creatures cannot be described in the formulæ of physicochemical happenings, and there is in the organism an autonomous regulative force or entelechy. Biologists oscillate between these two positions, or dogmatically entrench themselves in either of them, very much as philosophers did in regard to empiricism and rationalism before Kant's critique showed a better way. Dr. Strecker seeks to be a daysman between the two biological schools, laying his hands upon them both, pointing out that there is truth on both sides, but that there is a third outlook which dominates both. For the practical methods and analytic results of the “Entwicklungsmechaniker,” such as Roux, the author has an appreciative respect; his criticism is epistemological rather than biological; he does not think that there is any hope of rationally interpreting organisms in mechanistic formulæ. For the neo-vitalists he has also much that is good to say, for they at least do not give a false simplicity to the facts of life; on the other hand, he does not hold with an “entelechy,” which seems to be an ingenuous way of bundling all the difficulties into one term, and saying “there's an end of it.” The fact is that the mechanists and the vitalists are tarred with the same stick, they are *ekgenetic*, they seek to interpret results which have come to be, instead of concentrating attention on the process of becoming, which is the